ROAD AND LAND-USE SURVEY OF GAZOS CREEK WATERSHED

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Prepared by:

Maya T. Conrad, Watershed Outreach Manager
Coastal Watershed Council
903 Pacific Ave #207A
Santa Cruz, CA 95060
office@coastalws.org

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HISTORICAL AND CURRENT LAND USE IN THE WATERSHED

The Gazos Creek watershed has a long history of logging and agriculture since the 1870's. Roads were built to provide access to timber, mills and rural homes. Since the late 1800's, a network of roads, including skid and haul roads, has been developed within the watershed. A brief history of land use to present day within the various regions of the watershed is described below.

Within the lower elevations, from Cloverdale Road west to the ocean, the area surrounding Gazos Creek has been used for agriculture and cattle grazing stemming back to the turn of the century. From Cloverdale Road east, the Cloverdale Ranch (5600 acres) was acquired in the 1990s by the Peninsula Open Space Trust.

Old Woman's Creek, the lower southern tributary of the Gazos Creek Watershed (Plan Figure 2) was once a favored spot for fishing in the early 1900's (Conant 1998). At present no steelhead are thought to spawn in this tributary (Nelson 1994, Smith pers. comm.).

From the late 1860's through the turn of the century, Gazos Creek watershed was logged in a boom or bust fashion utilizing steam donkey engines and oxen (Conrad and Meyers 1997). During this time, the majority of the watershed was heavily cut, primarily by clear cutting. In 1867, the first steam shingle mill, the Burch and Steen Shingle Mill, was established at the mouth of Slate Creek (Conant, 1998). Shortly thereafter, the Pacific Lumber and Mill Company was opened at the confluence of the North Fork and mainstem of Gazos Creek. Since that time, approximately ten milling operations have been established along the creek for short periods of time (Stanger, 1967).

During the turn of the century, many of the logging operations lasted only a few years. Economic depressions and unfulfilled promises of a railroad connecting Santa Cruz to San Francisco led to the demise of most of the mills within the Gazos Creek region (Stanger, 1967). In lieu of the railroad, a makeshift port at nearby Pigeon Point was used to transport lumber including railroad ties headed for Hawaii, but could not replace the capabilities of a railway. Apparently, lumber could be transported as cheaply from the Puget Sound (in Washington) to San Francisco as it could from the Santa Cruz Mountains to Santa Cruz. By the 1940's, only one mill site (formerly the Pacific Lumber and Mill site) remained in Gazos Creek watershed, but soon ceased operations.

After a period of dormancy, timber interests were rekindled in the North Fork of the watershed. J.C. Ainsley purchased 1800 acres (Conrad and Meyers, 1997) along the North Fork and mainstem of Gazos Creek in the 1940's. In the 1950's, a road was built up the North Fork to access the trees in the upper reaches of the drainage and was subsequently logged. Although some of the last stands of old growth remained in this portion of the watershed, it was substantially cut over in the 1950's in a fairly harsh operation (Conrad and Meyers 1997). By the 1960's, a substantial network of logging roads had been built within the North Fork watershed.

Within the headwaters of the Middle Fork, 2600 acres, including the large mill site, were purchased by Paul Hanna in the late 1950's and named the Gazos Creek Tree Farm (Conrad and Meyers 1997). Hanna, a professor of education at Stanford University, became a pioneer of sustained yield harvesting and progressively managed the tree farm until the early 1980's. Redwood Empire purchased the tree farm shortly thereafter. Since 1984, ten timber harvests within this parcel have occurred. An additional 47-acre timber harvest plan (THP) is currently proposed near the confluence of Bear Gulch on the south side of Gazos Creek within Sections 33 and 34 in the Franklin Point quadrangle (California Department of Forestry, 2002).

From 1965 through 1968, the mill site on Hanna's Tree Farm was converted into a summer athletic camp that was run by Stanford University. The old millpond, which diverts water from the Middle Fork (visible on both topographic maps and aerial photos), was converted into a recreational swimming and boating area. In 1986, the camp was sold to Agape Christian Team and operated as a summer camp. In 1990, the Pacific Culture Foundation, a Taiwanese business collective, purchased the camp and renamed it the Villa Cathay. The camp was purchased by the Sempervirens Fund in 1997, and deeded to the California State Parks in 2000. At present, the camp is leased by the Pescadero Conservation Alliance, an organization that intends to operate the camp as an environmental camp and restoration center.

Today, only fragments of residual old growth stands remain within Gazos Creek watershed). Several residual old growth trees are nestled on the steep headwater slopes of the North Fork within the old Ainsley property. In 1997, the Sempervirens Fund purchased eight hundred acres, which contains habitat for federally protected marbled murrelets; this parcel is now owned by the State Parks. The Hicks family owns the remaining 960 acres of the Ainsley property within the North Fork.

Road-associated hydrologic, geomorphic and habitat alteration

Landsliding, large scale gully erosion and stream bank erosion are common, natural sources of erosion within watersheds and streams (Pacific Watersheds Associates 2001). The presence of roads alter hydrologic and geomorphic processes by: increasing rates of surface erosion and landsliding, changing peak flow magnitude, increasing stream sedimentation and altering channel morphology (Wemple et al, 1996). Direct sediment delivery from roadways and stream crossings can negatively impact aquatic biota, including salmonids (Furniss and others 1997), which rely on freshwater environments for essential life cycle functions such as spawning, rearing and migration.

In recent decades, research has focused on assessing environmental impacts of logging road networks (Furniss and others 1998, Trombulak and Frissell, 2000, Wemple et al, 1996; Jones and Grant, 1996, Mount, 1995, Reid and Dunn, 1984; McCashion and Rice 1983). A variety of road construction factors contribute to sedimentation and increased runoff including: the density of a road network within an area; steepness of the terrain; slope stability; and soil erodibility (Mount, 1995). Road-stream crossings are sources for

significant sedimentation, especially where plugged or inadequately sized culverts are present (Furniss and others 1998). In forested watersheds devoid of roads, runoff from precipitation percolates into the soil and may travel at shallow subsurface levels prior to entering the stream network. Exposing and compacting bare soil, creating inboard ditches and road cuts, and placing culverts increases the rate at which surface runoff and suspended sediment enters the stream system and extends the surface flow path of water (Wemple et al., 1996). Peak flow may also increase as a result of road-stream connectivity and channel network extension.

Some of the greatest risks to Gazos Creek fisheries are erosion and sedimentation. Stream-side road, fill and crossing failures from roads can greatly increase natural erosion rates and channel sedimentation. Gazos Creek Road, a San Mateo County-maintained road, leads from Highway One east along Gazos Creek for 6.7 miles (Figure _). The paved portion of the Gazos Creek county road closely borders the mainstem of the creek through the lower watershed. Old Woman's Creek landowners and State Parks maintain an unpaved road that leads from Gazos Creek Road at the Cloverdale Road junction three miles south to the headwaters of Old Woman's Creek. In the upper watershed, the County road continues past mile 6.7 as a dirt road and parallels the steep Middle Fork of the creek, past the headwaters up to the Sandy Point Guard Station within the boundary of Big Basin Redwoods State Park.

Within Bear Gulch, the South Fork tributary, a dirt road provides rural residential access and timber property access from the Gazos Creek road. The road follows the eastern side of Bear Gulch and connects to Johansen Road, along the southeastern ridge bordering the Gazos watershed. Several unmaintained logging roads are also present within the Gazos Creek watershed; including the Slate Creek haul road, North Fork haul road and many skid roads.

The combination of the Gazos Creek county road, infrequently maintained unpaved roads, and abandoned logging roads can degrade water quality and salmonid spawning habitat within Gazos Creek. Episodic erosion during storm events can also create unsafe driving conditions and access difficulties along the Gazos Creek Road. During the past two decades, major events such as 1982 and 1998 have forced extended closure of Gazos Creek Road due to massive road failures adjacent to Gazos Creek.

METHODS

A road evaluation was conducted utilizing the resources and budget available. A thorough road assessment will be conducted on all State Parks lands in San Mateo County (recently funded by the California Department of Fish and Game): the work will begin in 2003 or 2004. Additionally, the Bear Gulch road association hired William Lettis and Associates to conduct a road assessment and an erosion reduction plan on the Bear Gulch road during the summer of 2001.

For the assessment, aerial photographs were evaluated for the entire watershed by dividing the watershed into the following major subwatersheds:

North Fork
Middle Fork
Bear Gulch (South Fork)
Mainstem
Slate Creek
Old Woman's Creek

A geographic information systems (GIS) map was developed utilizing Arc/Info for the watershed by plotting roads viewed in aerial photographs from 1953, 1973, and 1993. Roads (including skid roads), stream channels and stream crossings were overlain on hill shade maps compiled from Franklin Point and Big Basin digital elevation models (DEMs). Based on results from aerial photo analysis, subwatersheds were ranked according to density of roads, area of exposed ground, and proximity of roads to drainages. Next, ground level reconnaissance occurred in areas where CWC staff had access permission (State Parks property and Sempervirens Fund property). Staff geomorphologists from Redwood National and State Parks conducted initial reconnaissance with CWC of mainstem, Middle Fork, and Old Woman's Creek drainage within the State Parks boundary; they briefly evaluated the North Fork remotely using aerial photographs.

A road inventory was conducted within the State Park portion of Old Woman's Creek. Protocols used include the draft California Department of Fish and Game Chapter 9 Upslope Assessment and Restoration Practices (Pacific Watershed Associates), and Redwood National and State Parks Watershed Restoration Department methodologies.

RESULTS

The results of the varying levels of surveys are discussed by subwatershed.

North Fork

The North Fork of Gazos Creek within the upper watershed is comprised predominantly of Butano Sandstone with a thin lens of Santa Margarita Sandstone. Santa Cruz Mudstone is present near the confluence with the mainstem. The North Fork increases 1800' in elevation over 4.3 miles from the confluence to the headwaters (Nelson, 1994). Due to the presence of bedrock chutes near the confluence of the North Fork with the mainstem, coho are not likely to utilize the North Fork; however, resident trout occur within the North Fork above the bedrock chutes.

The majority of the North Fork area has been logged, primarily in the 1970s and 1980s. A main haul road parallels the creek and eventually connects to the Butano Fire Trail/Johansen Road connector. It is likely that adjacent skid roads are present. Due to lack of access permission, no field surveys were conducted within the North Fork. The steepness in slope and close proximity to the creek, indicate that potential for road failure and direct sediment delivery to the creek is high. Although the North Fork does not

provide coho habitat, identifying sediment sources and limiting sediment delivery here could be extremely important to minimize sedimentation in the mainstem.

Middle Fork

The steep Middle Fork of Gazos Creek consists of Santa Cruz Mudstone, Santa Margarita Sandstone and Butano Sandstone provides limited salmonid habitat. A complete fish barrier is present near the confluence to the mainstem associated with an old mill pond at the Pescadero Conservation Alliance camp.

The Gazos Creek Road, which parallels Gazos Creek becomes a dirt road at the Pescadero Conservation Alliance camp at mile 6.7. A handful of rural residential parcels are accessed from the dirt road but its primary use is for recreation purposes as a connector to Big Basin Redwoods State Park. In some places, the road is not more than fifteen feet from the channel and directly transports fill, including sidecasted material after grading, into the creek. An inboard ditch is also present along most of the dirt road.

Due to sedimentation and erosion associated with the road, the San Mateo County Public Works Department (Public Works) restricts winter vehicular access from October through April yet mountain biking use is still prevalent. In further efforts to minimize the negative impacts of the dirt road, the Public Works Department recently completed road improvements on one mile of unpaved road to reduce sedimentation to Middle Fork Gazos Creek (Lisa Ekers, personal communication). California Department of Fish and Game and the County of San Mateo provided funding for this project. A total of twenty seven rocked rolling dips, two 18" culvert replacements, one culvert installation, 4,000 lineal feet of outsloping, and berm removal were completed in early November 2002. Portions of the road may be rocked in the near future.

Out of commission logging landings also pose potential sediment delivery into the creek. One landing, on private property, is located on the south side of the County road adjacent to the Middle Fork, and receives road runoff and natural drainage. Water and materials being transported through fill material have a likelihood of transporting high volumes of sediment into the channel and efforts to reduce failure potential should be made.

Bear Gulch (South Fork)

Santa Cruz Mudstone is the predominant geology within Bear Gulch. Like the other upper Gazos watershed tributaries, Bear Gulch provides limited salmonid habitat due to steep terrain and natural barriers. Coastal Watershed Council volunteers have observed higher turbidity within Bear Gulch than the mainstem at the confluence several times during storm events since 1997. An unpaved road provides access for rural residential landowners and timber lands from Gazos Creek road. This unpaved road winds up to the ridge where it connects with the Johansen Road.

A site reconnaissance performed in November 2001 with members of the Bear Gulch road association indicated a strong need for road inventory and upgrade

recommendations but no road inventory performed as part of the watershed assessment. Instead, the road association decided to privately hire William Lettis and Associates, to conduct a road inventory and develop an erosion reduction plan. Based on inventory recommendations, the road association is currently pursuing funding to implement road upgrades to minimize erosion and sedimentation.

Mainstem

At the confluence of Gazos Creek with the Pacific Ocean, a mixture of sand dune and beach formation, marine terrace deposits, and the Pigeon Point formation comprise the lower .05 miles of watershed. The Purisima formation predominates the remaining lower watershed to Cloverdale Road. Throughout the rest of the mainstem region, Santa Cruz mudstone prevails.

Several skid roads are present upslope (north) of Gazos Creek Road from approximately mile 3 to mile 5. Ground-truthing of this area was completed in winter 2001. Although many remnant skid roads remain and the road network has changed drainage patterns, there is not a great deal of fill failure or erosion. Additionally, potential for direct delivery of sediment to the creek is very low due to the presence of Gazos Creek Road between the skid network and Gazos Creek. The primary result of the change in drainage patterns appears to be a dispersal of water that is not negatively impacting Gazos Creek. Therefore, extensive road inventory surveys were not conducted in this area.

Few roads were detected in aerial photos along the south side of Gazos Creek. During field reconnaissance, signs of historic logging, pre-dating heavy equipment use (1950s), are present: mill remains; a splash board dam; evidence of steam donkey logging; and remnants of an old haul road that parallels the creek channel are apparent. These logging practices did not alter the landscape to nearly the same magnitude that heavy equipment logging has been able to do. Additionally, much of the work that occurred in this area is over 100 years old and excessive failures were not observed. Therefore, the impacts observed within the mainstem, compared with other areas in the Gazos Creek watershed did not warrant an in-depth road inventory.

Slate Creek

Santa Cruz mudstone makes up the geology within the Slate Creek drainage. Although this tributary flows perennially, the bedrock-lined channel does not support much anadromous fish habitat (Gingras, pers. comm. 2002). The lower portion of the subwatershed is currently owned by the Sempervirens Fund and will eventually be transferred to the State Parks. Big Creek Lumber owns the upper (northern) portion of the drainage. Access within the upper portion was not obtained and therefore no thorough ground surveying was conducted for Slate Creek. However, the Sempervirens portion was surveyed in 1997 by Coastal Watershed Council and Redwood National Park staff.

A defunct logging road parallels Slate Creek to the east approximately 30 meters upslope.

A sizable landslide has obliterated the road approximately 200 meters north of Gazos Creek Road. This natural landslide, which was exacerbated by the old logging road, will be a continual erosion problem and would be difficult to stabilize if the road was reopened (Youngblood, pers. comm. 1997), although unsuccessful efforts were made to reopen the road for logging access in 1999 (Clausen, pers. comm. 1999). Along the roadbed, sidecasting of material has caused occasional slumping, probably during 10-year and greater storm events, and has delivered sediment into Slate Creek.

Within the channel, benchmarks remain indicative of a turn of the century roadbed probably used when oxen were used to haul logs (Youngblood, pers. comm. 1999). Indeed, a mill site was present in 1867 at the confluence of Slate Creek and Gazos Creek. Many cut old growth logs still remain on the hillslopes or in the channel; it is unclear why so many logs were cut but not removed for milling. A portion of the creek within Sempervirens Fund property contains exposed bedrock. Downstream of the exposed bedrock portion, sedimentation and deposits from the landslide were apparent in the channel.

Although a few log jams currently provide sediment storage upstream of the Gazos Creek Road culvert, a big storm event may trigger sediment transport to Gazos Creek. Decommissioning of the haul road could be a straightforward restoration project if access to the upper subwatershed was obtained.

Old Woman's Creek

Like much of the watershed, Old Woman's Creek is composed of Purisima formation and Santa Cruz mudstone. An unpaved four-wheel drive dirt road parallels the tributary from Gazos Creek Road leading to rural residential parcels in the upper subwatershed. The road receives heavy use year-round.

Several sources have listed Old Woman's Creek as a major sediment contributor to Gazos Creek. During winter storms, the mainstem of Gazos Creek is visually much more turbid downstream of the Old Woman's Creek confluence than it is upstream. Based on aerial photo analysis, Old Woman's Creek drainage contains the highest concentration of roads between 1953 and 1993 compared to the other areas evaluated within Gazos Creek watershed. From evaluation of aerial photos, there appears to be a lot of erosion occurring in the upper portion of the drainage but no access was granted to evaluate these areas of the drainage.

During the 1940s and 1950s, logging was the most intense within the middle and upper portions of the subwatershed, with roads prevalent on both sides of the northern ridge that divides Old Woman's Creek and the Gazos mainstem. Two primary roads were used historically, the existing Old Woman's Creek road and the northern ridge road. Although portions of the northern ridge road are overgrown today, the majority of the road is still visible in the 1993 aerial photos. By the early 1970s, an expansion of logging increased the road network into the uppermost portion of the watershed, throughout much of

Section 4 in the Franklin Point Quadrangle. All the roads found in the 1953 Old Woman's Creek data are still visible in the 1973 aerial photo.

By 1993, many of the smaller skid roads within the mid-section of the subwatershed are barely visible. A widened road and slope failures are apparent in the steeper sections of the headwaters associated with the ridge road. More roads are seen to branch off this ridge road.

Technical Assessment of Old Woman's Creek road survey

At present, the unpaved road that parallels Old Woman's Creek is the primary road for vehicles to access the State Park and private properties within the subwatershed. Several skid and haul roads are associated with the primary access road. The two main sources of chronic and episodic sedimentation to Old Woman's Creek within State Parks property are the unpaved road and skid and haul roads between the unpaved road and Old Woman's Creek.

The Old Woman's Creek Road was not originally built for winter travel, yet it receives a relatively high volume of travel year-round. Steep terrain and infrequent and inadequate road drainage are the primary causes of sedimentation to Old Woman's Creek from the unpaved road. Less than ten functioning culverts over 1.7 miles of road are currently present. The inboard ditch, necessary due to the steepness of the area, is clogged in several locations and increases the diversion potential in many places.

Old Woman's Creek Road was surveyed from the gate at the County line to the Gazos Creek Road (1.7 miles), on the State Parks portion of Old Woman's Creek Road. A small percentage of the skid roads adjacent to the road and the creek channel were also surveyed. A road inventory data form was developed with the oversight of Redwood National and State Parks staff, based on the protocols developed by Pacific Watershed Associates and Redwood National and State Parks.

A total of forty-seven sites were inventoried during the 2001 spring. Seven of the sites inventoried are skid roads adjacent to Old Woman's Creek Road. The remaining sites are associated with Old Woman's Creek road.

Old Woman's Creek Road Evaluation Results

Based on the inventory (Table 1), the site types examined included the following:

- 1 landslide
- 4 stream crossings
- 5 road bed issues
- 6 ditch-relief culverts
- 7 skid roads
- 33 road-related drainage issues

There is a severe lack of drainage relief along the State Park portion of Old Woman's Creek road, especially on the upper 0.8 miles of road surveyed from the County line where the terrain is extremely steep. On steep slopes, drainage measures such as culverts, rolling dips and/or cross drains should be placed every 50-100 feet to reduce road drainage impacts (Neal Youngblood pers. comm., Santa Cruz Resource Conservation District 1988). Based on this information, additional drainage relief measures were recommended to the overall road treatment recommendation after the inventorying was conducted.

Thirty-four drainage relief prescriptions are proposed for the upper 0.8-mile of the unpaved road on State Park property due to the steep terrain (see map). These management practices will include a combination of stream crossing and ditch relief culverts and rocked, rolling dips. Other associated prescriptions will include flared culvert inlets, trash racks, and downspout dissipaters to improve effectiveness and reduce maintenance requirements. Outsloping has only been recommended at select sites due to a combination of steep slopes, need for winter travel and close proximity of road to the creek.

Proposed treatments for sites on Old Woman's Creek road are listed in Table 2. No treatments were proposed for adjacent skid and haul roads based on guidance from State Parks staff who recommended first addressing the main road. In many cases, multiple treatments were prescribed for a site. Treatment choices were based on immediacy of sedimentation or erosion, future sediment yield, and road grade.

A total of forty-seven rolling dips and twenty-nine culverts were prescribed for the entire 1.7-mile section. Within the lower portion of the road, six spring drains were prescribed to alleviate ponding water. Outsloping was recommended for a total of 1215 lineal feet. Maintenance of the inboard ditch was recommended throughout the road length. Finally, in two places, fill excavation and reconstruction of the road prism were also recommended.

Chronic surface erosion accounts for a large proportion of sediment delivery to Old Woman's Creek. Using the following calculation (Pacific Watershed Associates 2001):

$$Q_s = (A*E)/27 * T * D$$

Where Q_s = sediment delivery (yds^3) from surface erosion
A = exposed area (ft^2)
E = erosion or lowering rate (0.02 ft/yr)
T = time (10 years)
D = delivery ratio (% of erosion that is delivered to the stream)

The total amount of surface erosion that will be delivered to Old Woman's Creek over a 10 year time period was calculated at:

$$(112{,}322*0.02)/27 * 10 * 0.8 = \mathbf{665\ yds^3}$$

Conservative calculations for potential episodic sediment delivery totaled 17,035 cubic yards. Sediment volumes per site should be verified during the State Parks road inventory.

A proposal to perform the recommended treatments was prepared in May 2002 for California Department of Fish and Game funding.

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Aerial Photographs

I. U.S. Geologic Survey aerial photos:
Franklin Point quadrangle, San Mateo County, 1953: 3-27 - 3-31, 3-63 and 3-64.

II. Pacific Meridian aerial photos:
Franklin Point quadrangle, San Mateo County. 1993.

III. University of California Santa Cruz map collection aerial photos:
Franklin Point quadrangle, San Mateo County, 1973.

Site Number	Proposed Treatment #1	Proposed Treatment #2	Proposed Treatment #3	Proposed Treatment #4	Proposed Treatment #5	Sediment Saved (cu yd)
Begin: County line/Gate						
	install 18" culvert	install trash rack	downspout dissipator			
GAZ-01-00-01	Install 12" culvert	install trash rack	rocked, rolling dip	downspout dissipator		150
GAZ-01-00-02	install 18" culvert	install flared inlet	rocked, rolling dip	downspout dissipator		100
GAZ-01-00-03	replace 18" culvert	install trash rack	rocked, rolling dip			200
	Install 12" culvert	install trash rack	rocked, rolling dip			
	Install 12" culvert	install trash rack	rocked, rolling dip			
	rocked, rolling dip					
	rocked rolling dip					
GAZ-01-00-04	install flared inlet	install trash rack	rocked, rolling dip	downspout dissipator		100
	Install 12" culvert	install trash rack	rocked, rolling dip			
	Install 12" culvert	install trash rack	rocked, rolling dip			
	rocked, rolling dip					
GAZ-01-00-05 to -07 (450 ft)	outslope road	raise road prism to allow i/b ditch to drain water	rock road			600
	Install 12" culvert	rocked, rolling dip	install trash rack			
GAZ-01-00-05	Install 18" culvert	install trash rack	rocked, rolling dip	downspout dissipator		225
	rocked, rolling dip					
GAZ-01-00-06	install 12" culvert	install trash rack	rocked, rolling dip	downspout dissipator		25
	rocked, rolling dip					
GAZ-01-00-07	install 18" culvert	install trash rack	rocked, rolling dip	downspout dissipator		40
	Install 12" culvert	install trash rack	rocked, rolling dip			
	Install 12" culvert	install trash rack	rocked, rolling dip			
	rocked, rolling dip					
	rocked rolling dip					
GAZ-01-00-08	install 18" culvert	install trash rack	rocked, rolling dip	downspout dissipator		100
	Install 12" culvert	install trash rack	rocked, rolling dip	downspout dissipator		
GAZ-01-00-09	install trash rack					150
	Install 12" culvert	install trash rack	rocked, rolling dip	downspout dissipator		
GAZ-01-00-010	install 18" culvert	install trash rack	install flared inlet	inslope road (50ft)		830
GAZ-01-00-011	install 18" culvert	install trash rack	rocked, rolling dip	downspout dissipator		1025
	Install 12" culvert	install trash rack	rocked, rolling dip	downspout dissipator		
	rocked, rolling dip					
GAZ-01-00-012	install 18" culvert	install trash rack	rocked, rolling dip	downspout dissipator		250
	Install 12" culvert					
GAZ-01-00-013	install trash rack	install flared inlet (18" culvert)	place downspout dissipator	rocked, rolling dip		350
	Install 12" culvert	install trash rack	rocked, rolling dip	downspout dissipator		
	rocked, rolling dip					
GAZ-01-00-014	outslope road (265 ft from skid road 009 to -014)	rolling dip	rock o/s portion of road			300
GAZ-01-00-015	replace 12" culvert	rocked, rolling dip				20
GAZ-01-00-016 to -020 (500 ft)	outslope road	rock road				425

Site Number	Proposed Treatment #1	Proposed Treatment #2	Proposed Treatment #3	Proposed Treatment #4	Proposed Treatment #5	Sediment Saved (cubic yards)
GAZ-01-00-16	rolling dip					30
GAZ-01-00-40	install 18" culvert	install trash rack	rocked, rolling dip	downspout dissipator		25
GAZ-01-00-017	rolling dip					30
GAZ-01-00-018	rolling dip					30
GAZ-01-00-019	rolling dip					50
GAZ-01-00-020	rolling dip					20
GAZ-01-00-021	spring drain	rocked, rolling dip				30
GAZ-01-00-022	spring drain	rocked, rolling dip				20
GAZ-01-00-023	spring drain	rocked, rolling dip	brush layering at downspout	(brush layering area= 54 sq.ft)		95
GAZ-01-00-024	excavate crossing fill	install 18" culvert	rocked, rolling dip	install flared inlet	brush layering at downspout (area=82 sq. ft)	5000
Pine Gully GAZ-01-00-025						5010
GAZ-01-00-026	Install 12" culvert	install trash rack	rocked, rolling dip	downspout dissipator		35
GAZ-01-00-027	rocked, rolling dip					15
GAZ-01-00-028	replace 12" culvert	rocked, rolling dip				370
GAZ-01-00-029						885
GAZ-01-00-030	spring drain	rocked, rolling dip				15
GAZ-01-00-031	spring drain	rocked, rolling dip				40
GAZ-01-00-032	rocked, rolling dip					20
GAZ-01-00-033	rocked, rolling dip	repair downspout				15
GAZ-01-00-034	rocked, rolling dip					75
GAZ-01-00-035	install 18" culvert	install flared inlet	rocked, rolling dip	downspout dissipator		110
GAZ-01-00-036	spring drain	rocked, rolling dip				25
GAZ-01-00-037	Install 12" culvert	rocked, rolling dip				30
GAZ-01-00-038	rocked, rolling dip					20
GAZ-01-00-039						150
GAZ-01-00-036 to bridge (400ft)	reconstruct road prism	rock road				
GAZ-01-00-01 to -036 (1.7 miles)	Clean i/b ditch throughout State Parks road					
End: Bridge at Gazos Creek						
					Total	17035

Chronic Erosion: Sediment Saved Formula is
(A*E)/27 * T *D

A = Erosion Area T = Time (10 years)

D = Delivery Ratio (50% for >250' to stream) E = 0.03 (Native Surface roads erosion rate ft/yr)
(75% for 150' to 250' to stream crossing) (100% for stream crossings and <
150' to stream)